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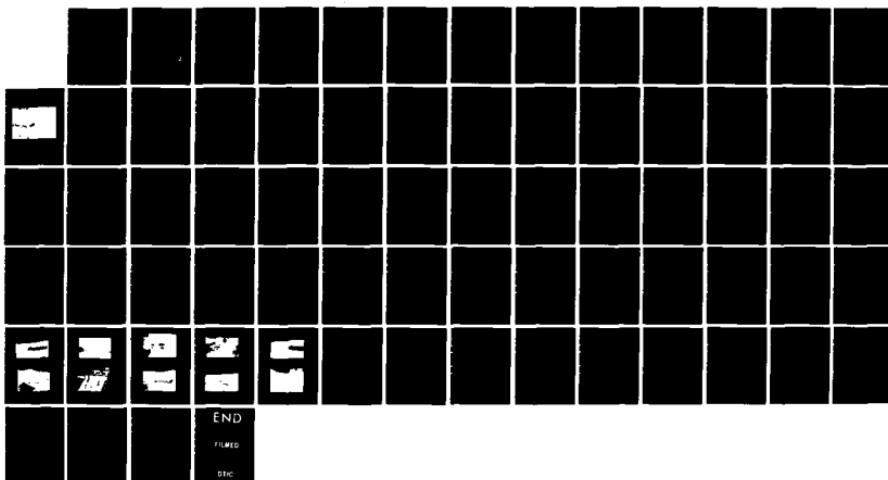
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS  
UPPER GROVETON DAM NH. (U) CORPS OF ENGINEERS WALTHAM  
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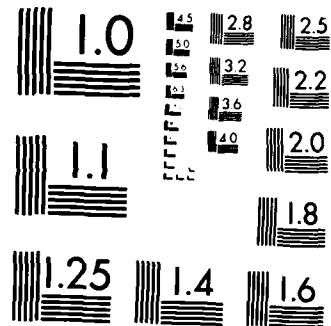
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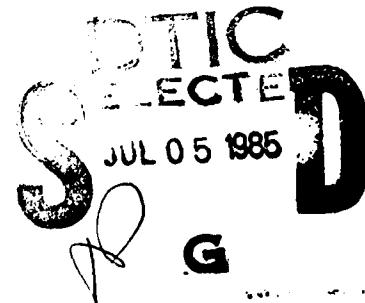
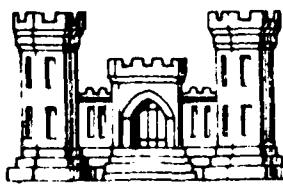
AD-A155 998

CONNECTICUT RIVER BASIN  
GROVETON, NEW HAMPSHIRE

UPPER GROVETON DAM  
N.H. 00148

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
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FEBRUARY 1979

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  DAMS, INSPECTION, DAM SAFETY,  Connecticut River Basin Groveton, New Hampshire Upper Ammonoosuc River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The dam is a run of the river, timber crib stone fill dam with concrete abutment and flood gates. It is 120 ft. long and 21 ft. high. It is small in size with a low hazard classification. The dam was found to be in good overall condition based on the limited visual inspection. There are some indications of a flow of water downstream and beneath the right abutment.		



DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
424 TRAPELO ROAD  
WALTHAM, MASSACHUSETTS 02154

REPLY TO  
ATTENTION OF:  
NEDED

Honorable Hugh J. Gallen  
Governor of the State of New Hampshire  
State House  
Concord, New Hampshire 03301

JUN 18 1979

Dear Governor Gallen:

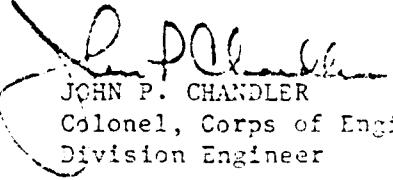
I am forwarding to you a copy of the Upper Groveton Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Mr. Michael LeDuc, Plant Engineer, Groveton Paper Company, Groveton, New Hampshire 03582.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely yours,

  
JOHN P. CHANDLER  
Colonel, Corps of Engineers  
Division Engineer

Incl  
As stated

UPPER GROVETON DAM

NH 00148

NORTHUMBERLAND, NEW HAMPSHIRE

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



NATIONAL DAM INSPECTION PROGRAM  
PHASE I INSPECTION REPORT

Identification No: NH00148  
Name of Dam: Upper Groveton Dam  
Town: Northumberland  
County and State: Coos, New Hampshire  
Stream: Upper Ammonoosuc River  
Date of Inspection: November 16, 1978

BRIEF ASSESSMENT

The Upper Groveton Dam is a run-of-the-river, timber crib stone fill dam with concrete abutments and flood gates. The length of the dam is 120 feet and it is 21 feet high. Flood gates and a former power house form the left abutment. The dam is currently used to provide process water to the Groveton Papers Company. Under normal conditions the dam impounds approximately 200 acre-feet and has a drainage area of 243 square miles.

The dam is classified as small and has a low hazard potential in the event of a dam failure. Based on size and hazard classifications, a 100-year flood of 13,100 CFS was used as the test flood. Because of the limited storage capacity, the test flood outflow is equal to the test flood inflow. The total spillway capacity, including the gates, is 14,150 CFS which is 108 percent of the test flood.

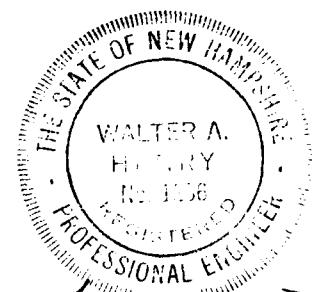
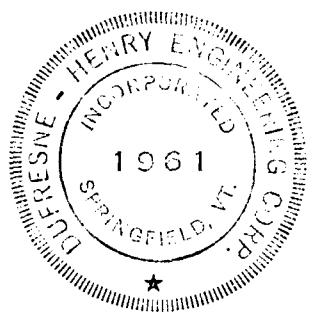
The dam was found to be in good overall condition based on the limited visual inspection. The following significant findings were determined during the investigation:

1. There are some indications of a flow of water downstream and beneath the right abutment.
2. Recent repairs reported by the Groveton Papers Company indicate that there may be some problems with the upstream dam face and foundation material.

Although the dam appears to be in good condition, the following actions are recommended to be instituted under the guidance of a qualified engineer within two years of the receipt of this report:

1. Inspect the upstream face of the dam and foundation with the reservoir dewatered.
2. Establish a procedure for the operation of the flood gates in the event of a major storm.

3. Institute a program of biennial periodic technical inspections.



*Walter A. Henry*

This Phase I Inspection Report on Upper Groveton Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

*Joseph W. Finegan*  
JOSEPH W. FINEGAN, JR., MEMBER  
Water Control Branch  
Engineering Division

*Joseph A. McElroy*

JOSEPH A. MCELROY, MEMBER  
Foundation & Materials Branch  
Engineering Division

*Carney M. Terzian*

CARNEY M. TERZIAN, CHAIRMAN  
Chief, Structural Section  
Design Branch  
Engineering Division

APPROVAL RECOMMENDED:

*Joe B. Fryar*  
JOE B. FRYAR  
Chief, Engineering Division

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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through the gates would pass through the power house and discharge into the tailrace channel. The discharge openings are, at the present time, covered with break-away partitions to control the temperature inside the building (see Photo 5). An additional flood gate is located in the intake channel wall which would divert water from the intake channel directly to the downstream side of the dam (see Photo 3).

The structural concrete of the power house and intake channel is in fair condition. There are some large spalled areas, especially on the downstream wall (see Photo 5) and leakage is occurring at several locations (see Photo 3). The leakage and efflorescence appears to be associated with the original construction jointing.

(2) Gate Works

The gate works consist of five gates with concrete training walls. Four of the gates are flood or waste gates and the fifth has a concrete sluiceway which was used to jam logs to the lower river (see Photo 4).

The four waste gates are seven feet wide and are equipped with electrical lifting devices. The fifth gate is only five feet wide and is operated by block and tackle.

The gate works are in good overall condition. Spalling concrete has been patched and the entire service platform has received a new concrete cap. All of the equipment, hand rails, steps, ladders, etc., are in sound structural condition and have recently been painted.

(3) Intake Structure (right side)

The intake structure located at the right abutment is a reinforced concrete and wood chamber with a bar screen. A 30-inch steel penstock carries the intake water to the processing area of the plant (see Photo 6).

d. Reservoir Area

The right bank of the reservoir area is presently occupied by a railroad and storage yard. This is the area where the washout occurred in 1953 and as a result, the embankment is now protected by a sheet pile coffer dam.

## SECTION 3 - VISUAL INSPECTION

### 3.1 Findings

#### a. General

The on-site inspection of the Upper Groveton Dam was performed on November 16, 1978. Water was flowing over the dam during the inspection, preventing visual observation of a good portion of the timber crib spillway structure. No emergency conditions were observed on the day of the inspection.

#### b. Dam

The timber crib dam structure was found to be in good condition, based on a limited visual inspection. All sections of the dam were intact and the vertical and horizontal alignments were good. The nonfailing flashboards were in place and there was no bulging or settlement observed (see Photos 1 and 2).

Water was flowing over all portions of the dam during the inspection. This prevented a more detailed inspection of the structure. As mentioned in Section 1.2, some repair work was recently performed on the dam. The nature of these repairs indicates that problem areas may exist in the upstream crib structure and the foundation material. Based on this information, a more ...-depth inspection of the dam appears justified.

Turbulence of the water was observed immediately downstream of the dam next to the right abutment. It could not be ascertained whether it was the result of seepage through the foundation or abutment soils or of the flow of water over the spillway.

#### c. Appurtenant Structures

##### (1) Existing Power House (left abutment)

The structural portions, building and foundation, of the old power house are still intact. The power generation equipment has been removed and the building is presently being used as a maintenance shop. The intake channel and head gate facilities are reported to be in good operational condition with electrical lifting mechanisms on all three gates. Under normal operating conditions the gates are closed. Any water passing

b. Adequacy

The lack of in-depth engineering data does not allow for a definitive review. Therefore, the adequacy of the dam, structurally and hydraulically, cannot be assessed from the standpoint of review of design calculations, but must be based primarily on the visual inspection, past performance history and sound hydrologic and hydraulic engineering judgment.

c. Validity

Not applicable.

## SECTION 2 - ENGINEERING DATA

### 2.1 Design

A timber or log crib dam is made of wood members bolted into cribs and filled with rock. This type of dam usually leaks considerably and its resistance against sliding is reduced by buoyant forces which decrease the effective weight of the dam. A relatively long sloping approach apron is also utilized to increase the resistance to sliding and reduce leakage. The life span of a timber crib dam varies between 10 and 40 years depending upon climatic conditions, amount of maintenance performed and type of timber used. Cedar, redwood and cypress are the most durable timbers.

The Upper Groveton Dam has been modified, rebuilt and repaired several times since its original construction in the early 1900s. The present configuration bears little resemblance to the dam shown in sketches and photographs in 1936. All past design data which may have existed has either been destroyed or cannot be located by the Groveton Papers Company.

### 2.2 Construction

The present dam is a timber crib and stone spillway with concrete abutments and gate works. Those portions of the spillway which were visible are covered with wood plank. The foundation crib work is reinforced with steel railroad rails which also provide protection to the lower apron from ice and logs flowing over the spillway. The plans found in Appendix B were drawn, based on visual observations and descriptions in the records and approximate the existing physical construction of the dam.

### 2.3 Operation

The flow of water to the plant is controlled at the plant. Therefore, there is no physical operation at the dam during normal flow conditions. Flood gates are operated on an as-needed basis to suit higher flow conditions.

### 2.4 Evaluation

#### a. Availability

The design and construction records for this dam are not available.

j. Regulating Outlets

In addition to the 30-inch penstock, there are a total of nine gates which may be used to regulate the flow at the dam. There are five waste gates located adjacent to the spillway. Four of these gates are 7' x 17' with an invert of 81.8. The fifth gate is a smaller 5' x 9.5' with an invert of 89.3. It is believed that the smaller gate was used to jam logs to the lower river. The four large gates are equipped with electric operating mechanisms while the smaller gate is lifted by block and tackle.

The sixth waste gate is located in the intake channel wall just upstream of the power house. The gate is 9' x 9' with an invert of 84 $\frac{1}{2}$ . This gate is also equipped with an electric operator.

The old power house includes three head gates. The power house was not completely accessible during the inspection and the dimensions and inverts of these gates could not be obtained. These gates were also equipped with electric lifting mechanisms and are reported to be operational.

(5) Side Slopes

Not applicable.

(6) Zoning

None known.

(7) Impervious Core

Not applicable.

(8) Cutoff

Not applicable.

(9) Grout Curtain

Not applicable.

h. Diversion and Regulating Tunnel

Not applicable.

i. Spillway

(1) Type

Timber crib with 2.5-foot flashboards.

(2) Length

120 feet.

(3) Crest Elevation

Top of flashboards - 93.5  
Permanent spillway - 91.0

(4) Gates

Six waste gates - varying sizes. Three head gates at power house.

(5) Upstream Channel

Upper Ammonoosuc River.

(6) Downstream Channel

Upper Ammonoosuc River.

Maximum Tailwater	Variable
Upstream Portal Invert	Not Applicable
Recreation Pool	93.5
Full Flood Control Pool	99.4
Spillway Crest (Top of Flashboards)	93.5
Design Surcharge	99.4
Top of Dam	99.4
Test Flood Surcharge	98.5

d. Reservoir

Length of Maximum Pool	4200
Length of Recreation Pool	3200
Length of Flood Control Pool	4200

e. Storage

Recreation Pool	66
Flood Control Pool	216
Test Flood Pool	216
Spillway Crest Pool	66

f. Reservoir Surface

Top of Dam	24
Test Flood Pool	24
Flood Control Pool	24
Recreation Pool	16
Spillway Crest	16

g. Dam

(1) Type

Timber crib and stone with concrete abutments, run-of-the river dam.

(2) Length

325 feet overall.  
120 feet spillway.

(3) Height

21 feet.

(4) Top Width

Not applicable (flashboards).

\*Estimated, based on USGS topographic maps and visual observations.

steel penstock carries river water to the plant processing area. The maximum capacity of the penstock is estimated at approximately 20 CFS. The penstock is not equipped with a gated control mechanism and any flow which is not required for process water is bypassed to the river at the filter plant.

(2) Maximum Known Flood at Dam Site

The maximum recorded flood flow at the Upper Ammonoosuc gauging station, located approximately 3 miles upstream of Groveton, occurred on May 20, 1969. This flood flow of 24,100 CFS was the result of a failure of the Nash Bog Pond dam located on Nash Stream, a tributary to the Upper Ammonoosuc River. This flow is equivalent to a gauge height of 12.01 feet. The maximum known storm related flow occurred in March 1936, but was not recorded on the Upper Ammonoosuc because the gauge was not installed until 1940. Based on water marks from that storm compared to the existing gauge, the March 1936 flow was approximately 12,000 CFS. This storm is believed to have caused extensive damage to the Upper Groveton Dam, requiring the repairs referenced in the August 1936 State inspection. Another major storm occurred on March 27, 1953 with an estimated storm flow of 9,950 CFS causing a major breach around the right abutment. The breach caused a shut-down of the Groveton Papers Company and extensive repairs including a steel sheet pile coffer dam along the right embankment.

(3) Spillway Capacity

The spillway has 2.5 feet high flashboards which are apparently not designed to fail in case of flood. The spillway has a capacity of approximately 3950 CFS with the flashboards in place. If all six flood gates are open, an additional 8590 CFS will be added for a total capacity of 12,540 CFS. Since the operation of the dam is essential to the Groveton Papers Company, it was reported that these gates will be operated in the event of major storm flow. Additional capacity can also be obtained by opening the old power house head gates and allowing water to flow through the old power house. Since the internal constrictions of the old power house were not determined, the flow capacity could not be determined.

c. Elevations

(Based on an assumed bench mark of 100.0 on the power house intake channel retaining wall - see plan for exact location.)

Streambed at Centerline of Dam

77.0(estimated)

The last inspection took place on October 27, 1972. During that inspection the condition of the concrete abutments and training walls was rated as fair to poor because of excessive spalling. As a result of this inspection, remedial action was taken in 1975. The spalling concrete was repaired and a new concrete surface was placed on the service platform.

In the summer of 1978 an underwater inspection of the dam revealed some minor deterioration of the upstream face and a significant cavity under the timber crib foundation. A reinforcing fiber cloth was applied to the upstream face of the dam and the cavity was filled with approximately 18 cubic yards of concrete.

i. Normal Operating Procedures

Under normal operating conditions all gates are closed and the water level is controlled by the spillway (with flashboards) and the water flowing to the Groveton Papers plant. The dam and gate works are under 24-hour surveillance by the plant's maintenance and security forces. In the event of high river flows, the appropriate personnel are contacted to operate the gates.

The flow of water through the penstock does not have a gated control mechanism. The penstock water flows to a filter plant before becoming process water. Water which is not required for processing is bypassed to the river at the filter plant.

1.3 Pertinent Data

a. Drainage Area

The drainage area above the Upper Groveton Dam contains approximately 243 square miles of rolling hills and mountainous terrain. Approximately 50 percent of the basin, south of the Upper Ammonoosuc River is within the White Mountain National Forest. The Upper Ammonoosuc River has a length of approximately 32 miles with an average slope of 87 feet per mile. Elevations vary from 1000 feet along the river to 4000 feet at the ridge of the Pilot Mountain range in the White Mountain National Forest. The soils are predominantly glacial till overlying bedrock and hardpan within 3 feet of the surface.

b. Discharge at Dam Site

(1) Outlet Works

Outlet works, consisting of a trash screen and intake box are located at the right abutment. A 30" diameter

The dam was used previously for power generation. The power house, intake facilities and discharge channel, located at the left embankment, are intact. All mechanical power generation equipment has been removed and the power house is presently being used as a maintenance shop. The electrically operated head gates are reported to be in good operating condition.

h. Design and Construction History

Very little information is available on the original construction of the dam and power house. Design drawings and operating records have been either destroyed or could not be located by the Groveton Papers Company.

The original dam was constructed in the early 1900s. Several inspections, on file with the New Hampshire Water Resources Board, indicate that the dam has been partially or completely reconstructed several times since the original construction and it is not known if any of the existing dam dates back to the original.

The present dam is a timber crib and stone dam with concrete abutments. The timber cribbing is completely covered with planking and appears to be in good condition. The base of the dam is reinforced with steel rails which protect the lower apron section from damage due to ice flowing over the dam.

An inspection of the dam performed on August 10, 1936, noted that the dam was in poor condition and being repaired. Also two additional waste gates were being constructed. The photos and sketches accompanying that inspection report show that the original dam included three waste gates and a log sluiceway with log crib training walls. These log crib structures have since been replaced with concrete training walls and a concrete service platform.

The next correspondence on file with the New Hampshire Water Resources Board is a newspaper article and several pictures concerning a washout of the dam which took place in late March 1953. The information indicates that the washout occurred around the right abutment, in the area presently occupied by the railroad and storage yards. Repairs to the dam included the installation of sheet piling along the right upstream bank which can be seen in Photos 2 and 7. The article also indicates that some damage was sustained by the dam itself although details of the damage were not given. A photo of the dam does not show any major structural damage other than the washout around the right embankment.

embankment includes an intake and screen chamber for a 30-inch diameter penstock which supplies process water to the Groveton Paper Mill. Under normal conditions, all gates are closed and the water level is controlled by the spillway.

c. Size Classification

The Upper Groveton Dam has a maximum height of 21 feet and an estimated maximum storage volume of 380 acre-feet. The USCE Guidelines place dams with maximum heights between 25 and 40 feet and maximum storage between 50 and 1000 acre-feet in the small category. Therefore the size category of the Upper Groveton Dam is small.

d. Hazard Classification

A failure of the Upper Groveton Dam would release a flood wave into the lower river channel. The river channel below the dam is wide and well defined. If the dam were to fail, the lower channel has adequate capacity to handle the flood wave without overbank flow. Therefore the hazard category is low.

e. Ownership

The present owner of the Upper Groveton Dam is:

Groveton Papers Company  
Groveton, New Hampshire 03582

f. Operator

The operation and maintenance of the dam is under the supervision of:

Mr. Michael LeDuc, Plant Engineer  
Groveton Papers Company  
Groveton, New Hampshire 03582

Telephone: 603-636-1154

g. Purpose

The present purpose of the Upper Groveton Dam is to provide process water to the Groveton Papers Company. The Upper Dam is one of two dams intended to impound and divert water to the plant's processing facilities. Water is conveyed to the plant via a 30-inch diameter penstock which begins at the intake chamber located at the right abutment.

NATIONAL DAM INSPECTION PROGRAM  
PHASE I INSPECTION REPORT  
NAME OF DAM: UPPER GROVETON

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Dufresne-Henry Engineering Corporation has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Dufresne-Henry Engineering Corporation under a letter of November 20, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0010 has been assigned by the Corps of Engineers for this work.

b. Purpose

- (1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by nonfederal interests.
- (2) Encourage and prepare the states to initiate quickly effective dam safety programs for nonfederal dams.
- (3) To update, verify and complete the National Inventory of Dams.

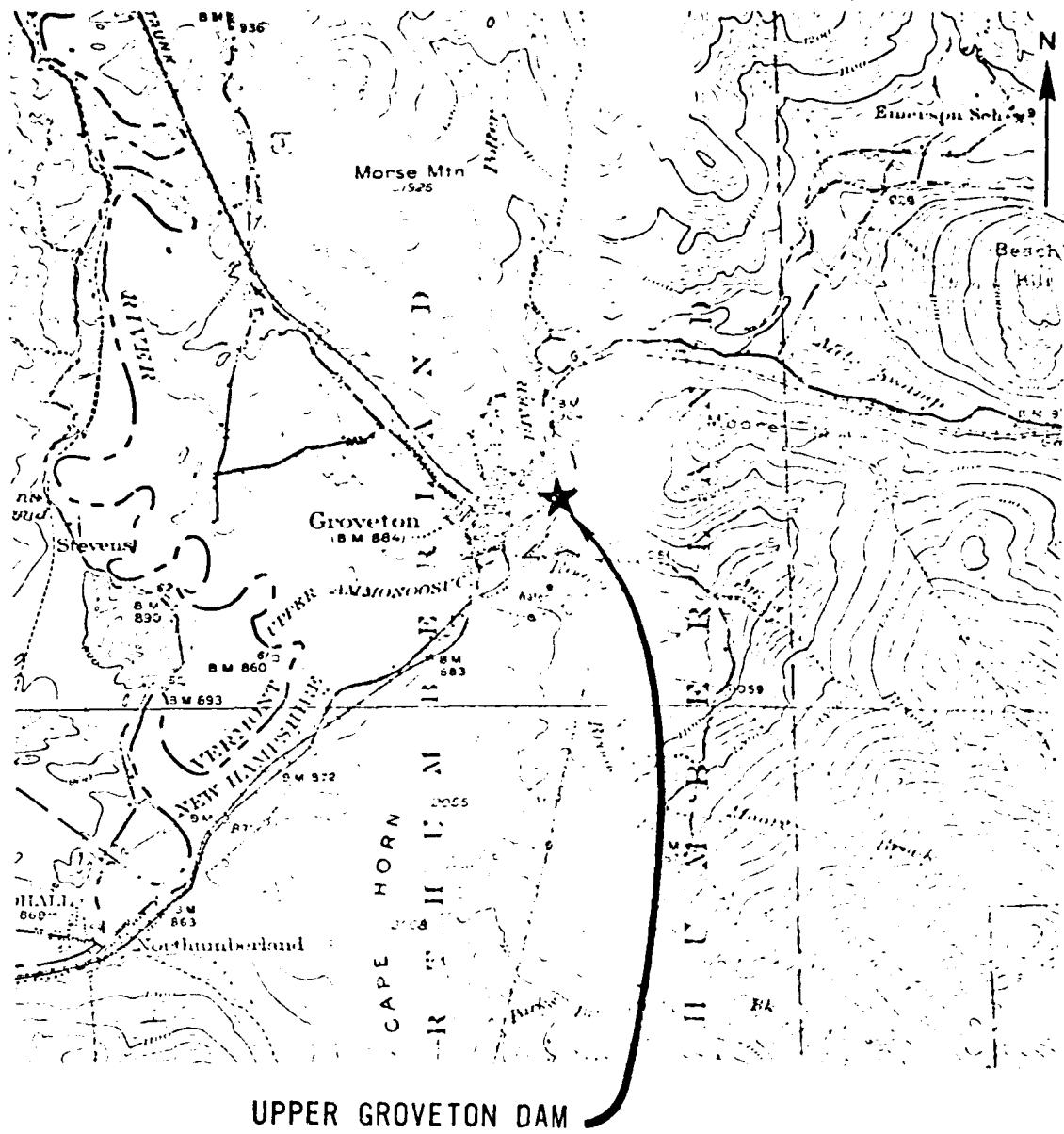
1.2 Description of Project

a. Location

The Upper Groveton Dam is located in northern New Hampshire in the Town of Groveton, Coos County. The dam is on the Upper Ammonoosuc River, approximately 1.5 miles upstream from its confluence with the Connecticut River.

b. Description of Dam and Appurtenances

Upper Groveton Dam consists of a 120-foot long timber crib, stone and concrete spillway. A power house, intake channel and gate works are located on the left embankment. The right



UPPER GROVETON DAM

DUFFLON-HENRY ENGINEERING CORP.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS BALTIMORE, MARY.
---------------------------------	-------------------------------------------------------------------------------

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SOURCE:

U.S.G.S. QUADRANGLE  
GUILDFALL, VT.-N.H.  
& PERCY, N.H.  
1:62,500 1956

LOCATION MAP  
UPPER GROVETON DAM

GROVETON  
CLIENT NO. 04-0084  
ENGR. JAC

NEW HAMPSHIRE



OVERVIEW OF  
UPPER GROVETON DAM  
NORTHUMBERLAND, NEW HAMPSHIRE

The only other significant feature of the reservoir area is a floating log boom located approximately 200 feet upstream of the dam. The log boom intercepts floating debris, preventing it from damaging or plugging the dam and gate works.

e. Downstream Channel

The channel below the dam is the natural river channel of the Upper Ammonoosuc River. The Groveton Papers Company is located along the right bank which has been filled and rip-rapped to reduce erosion and possible damage to the Paper Company buildings (see Photos 9 and 10). The left bank is a well vegetated natural river bank which shows no sign of recent erosion.

A cable suspension pedestrian bridge is located approximately 150 feet downstream of the dam. The right concrete pier and cable tower are within the river channel and have been subject to erosion. At present, the concrete pier appears to be resting on top of the stream bed, without any horizontal support. The pier may be subject to horizontal displacement during high river flow.

3.2 Evaluation

The Upper Groveton Dam appears to be in good condition based on a superficial visual inspection. Water flowing over the dam prevented a detailed inspection of the structural crib work. The repairs performed on the dam during the summer has resulted in some question as to the actual condition of the upstream face of the dam and the foundation material. A possible seep may exist at the right abutment as evidenced from some turbulence of the tailwater. These questionable features of the dam should be verified by a complete inspection during low flow conditions.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 Procedures

The 30-inch penstock carries water to a filter plant before entering the main plant. Water that is not required for process water is returned to the river at the filter plant. There is no means of controlling the flow of water through the penstock with the exception of lowering the reservoir level.

The dam and gate works receive 24-hour surveillance by maintenance and security forces. In the event of rising river flows, appropriate personnel are notified to operate the gates.

### 4.2 Maintenance of Dam

The Groveton Papers Company has recently instituted a semiannual inspection of the timber crib dam. An inspection uncovered several deficiencies which were repaired in the summer of 1978.

The concrete abutments, service platform railings, etc., are maintained on a regular basis, with periodic painting and repairs to spalling concrete.

### 4.3 Maintenance of Operating Facilities

The electrical gate lifting mechanisms are maintained on a regular basis which includes test running of electric drives and lubrication of gears.

### 4.4 Description of Warning System

None exists for this dam.

### 4.5 Evaluation

The operation and maintenance of the Upper Groveton Dam is adequate to maintain a safe and workable facility.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 Evaluation of Features

#### a. General

The Upper Groveton Dam is a run-of-the-river type dam, designed as a spillway for its entire length. Originally the dual purpose structure was used for both power generation and water supply, but the power house has been inactive for some time.

#### b. Design Data

No design data for the dam were available.

#### c. Experience Data

The maximum known flood on the Upper Ammonoosuc River occurred in March of 1969 and was caused by the failure of the Nash Bog Dam, resulting in a 24,100 CFS flow at the Groveton gauge. No record data could be found for any damage to the Upper Groveton Dam.

Reports of extensive damage were found for flood flows occurring in March 1936 (12,000 CFS, estimated) and March 1953 (9,950 CFS, recorded at the gauge). Since the operational configuration of the dam and flood gates during these events is not known, a hydraulic evaluation could not be made.

#### d. Visual Observation

- The dam and appurtenant facilities appear to be in good condition. A total of six flood gates appear to be in excellent working condition. In addition, the power house head gates could be opened to increase the total flood flow capacity.

#### e. Test Flood Analysis

The dam is classified to be small size with a low hazard classification. Since the hazard classification is low, a test flood of 100-year exceedance interval has been selected as a criterion for this study.

Record flow data was analyzed for USGS gauge 01130000, located approximately 2.8 miles upstream of the Upper Groveton Dam. The flow data was processed by computer in accordance with the "United States Water Resources Council Guidelines" (Bulletin 17). The results of the gauge analysis were adjusted to suit conditions at the dam by the ratio of their drainage areas to the three quarters power. This resulted

in a 100-year test flood flow of 13,100 CFS. Because of the limited storage, the test flood outflow was assumed equal to the test flood inflow.

Since the integrity of the dam is essential to the operation of the Groveton Papers Company, it was reported that the flood gates will be operated effectively during a major flood. Therefore, the capacity of the gates is included in the total capacity of the dam, with flashboards in place, of 12,040 CFS (at elevation 98). Overbank flow will not result until the water elevation exceeds the top of the sheet pile coffer dam at elevation 99.4. The estimated capacity at this elevation is 14,150 CFS, or 1,050 CFS more than the 100-year test flood. The test flood would result in a flow elevation of 98.5. The total spillway capacity represents 108 percent of the test flood.

Additional capacity is available by opening the power house head gates and passing flow through the old structure. Since the internal constrictions are not known, the hydraulic capacity was not calculated.

f. Dam Failure Analysis

Since the Upper Groveton Dam is a run-of-the-river dam, the storage is relatively small. During high flow conditions the dam would be partially backwatered by the high river flow and any failure during these conditions would produce a relatively small flood wave. The remaining storage in the downstream channel would be adequate to contain the flood wave without overbank flow.

Using the procedures outlined in the Guidelines, the estimated maximum dam failure flow is 16,200 CFS assuming a maximum reservoir level and no downstream backwater. This flow would quickly dissipate due to the downstream channel size and limited upstream storage.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability

#### a. Visual Observations

Based on a visual inspection alone, one cannot evaluate the structural stability of this dam. However, there are no signs of stability problems and the dam appears to be in good condition.

#### b. Design and Construction Data

There are no design and construction data available for this dam.

#### c. Operating Records

There are no formal operating records available for this dam. Data on file with the New Hampshire Water Resources Board from past inspections indicates that the dam sustained extensive damage as a result of floods in March 1936 and March 1953. No information as to the type or extent of the damage was available.

#### d. Post-Construction Changes

The original dam was constructed in the early 1900s. Several inspections and record data on file with the New Hampshire Water Resources Board indicate that the dam has been partially or completely reconstructed several times since the original construction and it is not known if any of the existing dam dates back to the original.

The first reconstruction was referenced in an inspection report dated August 10, 1936. It is assumed that the damage and repairs were a result of the severe storm flow of March 1936. During this reconstruction new flood gates were added and log sluice structures were replaced with concrete.

The next correspondence on file with the New Hampshire Water Resources Board is a newspaper article and several pictures concerning a washout of the dam which took place in late March 1953. The information indicates that the washout occurred around the right abutment, in the area presently occupied by the railroad and storage yards. Repairs to the dam included the installation of sheet piling along the right upstream bank which can be seen in Photos 2 and 7. The article also indicates that some damage was sustained

by the dam itself, although details of the damage were not given. A photo of the dam does not show any major structural damage other than the washout around the right embankment.

e. Seismic Stability

The dam is in seismic zone 2 and in accordance with recommended Phase I Guidelines, does not warrant seismic analysis.

## SECTION 7 - ASSESSMENT, RECOMMENDATIONS/ REMEDIAL MEASURES

### 7.1 Dam Assessment

#### a. Condition

Based on the records and the visual inspection performed on November 16, 1978, this dam appears to be in good condition. The repairs performed during the summer of 1978 indicate that some problems may exist which could not be observed during the inspection because of the water flowing over the dam. A final evaluation of the dam cannot be made until additional information is obtained and an inspection is performed of the upstream portions of the dam and of the downstream toe.

#### b. Adequacy of Information

The lack of in-depth engineering data does not allow for a definitive review. Therefore, the evaluation of this dam, structurally and hydraulically, cannot be assessed from the standpoint of review of design calculations, but must be based primarily on the visual inspection, past performance history and sound hydrologic and hydraulic engineering judgment.

#### c. Urgency

The recommendations listed in 7.2 and 7.3 should be carried out within two years of the receipt of this report.

#### d. Need for Additional Investigation

The additional investigations described in Section 7.2 should be carried out.

### 7.2 Recommendations

As mentioned above, the dam appears to be in good condition and does not require any remedial action at this time. However, the following items should be addressed within two years of the receipt of this report:

1. Perform a thorough inspection by a qualified professional engineer, of the dam under low flow conditions with the reservoir dewatered, noting: the condition of the crib wall, condition of the foundation soils at the downstream toe for possible erosion or piping, and seepage through the foundation soils particularly next to the right abutment.

7.3 Remedial Measures

1. Repair spalled concrete on the power house foundation.
2. Develop an exact regulation scheme for operating the waste gates during major storm events.
3. Institute a program of biennial periodic technical inspections.

7.4 Alternatives

None.

APPENDIX A  
VISUAL INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST  
PARTY ORGANIZATION

PROJECT UPPER GROVETON DAM

DATE November 16, 1978

TIME 7:50 - 10:05 AM

WEATHER Partly cloudy, cool

W.S. ELEV.        U.S.        DN.S.

PARTY:

1. <u>Jim Maynes</u>	<u>D-H</u>	6. <u>      </u>
2. <u>Jim Dohrman</u>	<u>D-H</u>	7. <u>      </u>
3. <u>Sherward Farnsworth</u>	<u>D-H</u>	8. <u>      </u>
4. <u>Gonzalo Castro</u>	<u>GEI</u>	9. <u>      </u>
5. <u>Ken Stern, New Hampshire</u> <u>Water Resources Board</u>		10. <u>      </u>

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>      </u>		
2. <u>      </u>		
3. <u>      </u>		
4. <u>      </u>		
5. <u>      </u>		
6. <u>      </u>		
7. <u>      </u>		
8. <u>      </u>		
9. <u>      </u>		
10. <u>      </u>		

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAMDATE November 16, 1978

PROJECT FEATURE \_\_\_\_\_

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT - LOG CRIB</u>	*Water flowing over entire dam.
Crest Elevation	Permanent spillway 877.2 (USCS)
Current Pool Elevation	Same.
Maximum Impoundment to Date	380 acre-feet (estimated)
Surface Cracks	Not observed (water covered).
Pavement Condition	None.
Movement or Settlement of Crest	None observed (under water).
Lateral Movement	None observed.
Vertical Alignment	Good*
Horizontal Alignment	Good*
Condition at Abutment and at Concrete Structures	Fair*
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	N/A (Spillway)
Sloughing or Erosion of Slopes or Abutments	N/A
Rock Slope Protection - Riprap Failures	N/A
Unusual Movement or Cracking at or near Toes	N/A
Unusual Embankment or Downstream Seepage	None observed through dam; some indication of seepage at right embankment.
Piping or Boils	None observable.
Foundation Drainage Features	N/A
Toe Drains	N/A
Instrumentation System	None known.
Vegetation	N/A

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAMDATE November 16, 1978

PROJECT FEATURE \_\_\_\_\_

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - GATE CONTROL PLATFORM</u>	
a. Concrete and Structural	
General Condition	Good.
Condition of Joints	Good.
Spalling	Minor - recent concrete cap.
Visible Reinforcing	None.
Rusting or Staining of Concrete	None.
Any Seepage or Efflorescence	None observed.
Joint Alignment	Good.
Unusual Seepage or Leaks in Gate Chamber	Minor.
Cracks	None.
Rusting or Corrosion of Steel	None.
b. Mechanical and Electrical	
Air Vents	N/A
Float Wells	N/A
Crane Hoist	None.
Elevator	None.
Hydraulic System	None.
Service Gates	Electrical lifting mechanism on all gates.
Emergency Gates	Electrical lifting mechanism on all gates.
Lightning Protection System	None known.
Emergency Power System	None known.
Wiring and Lighting System in Gate Chamber	Outside lighting is provided for all gate mechanisms.

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAM DATE November 16, 1978  
PROJECT FEATURE \_\_\_\_\_ NAME \_\_\_\_\_  
DISCIPLINE \_\_\_\_\_ NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONDUIT</u>	30" Process water for mill.
General Condition of Concrete	Good at intake chamber.
Rust or Staining on Concrete	None observed.
Spalling	None.
Erosion or Cavitation	None.
Cracking	None.
Alignment of Monoliths	N/A
Alignment of Joints	None observed.
Numbering of Monoliths	N/A Screen chamber (wood) leaking at base.

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAMDATE November 16, 1978

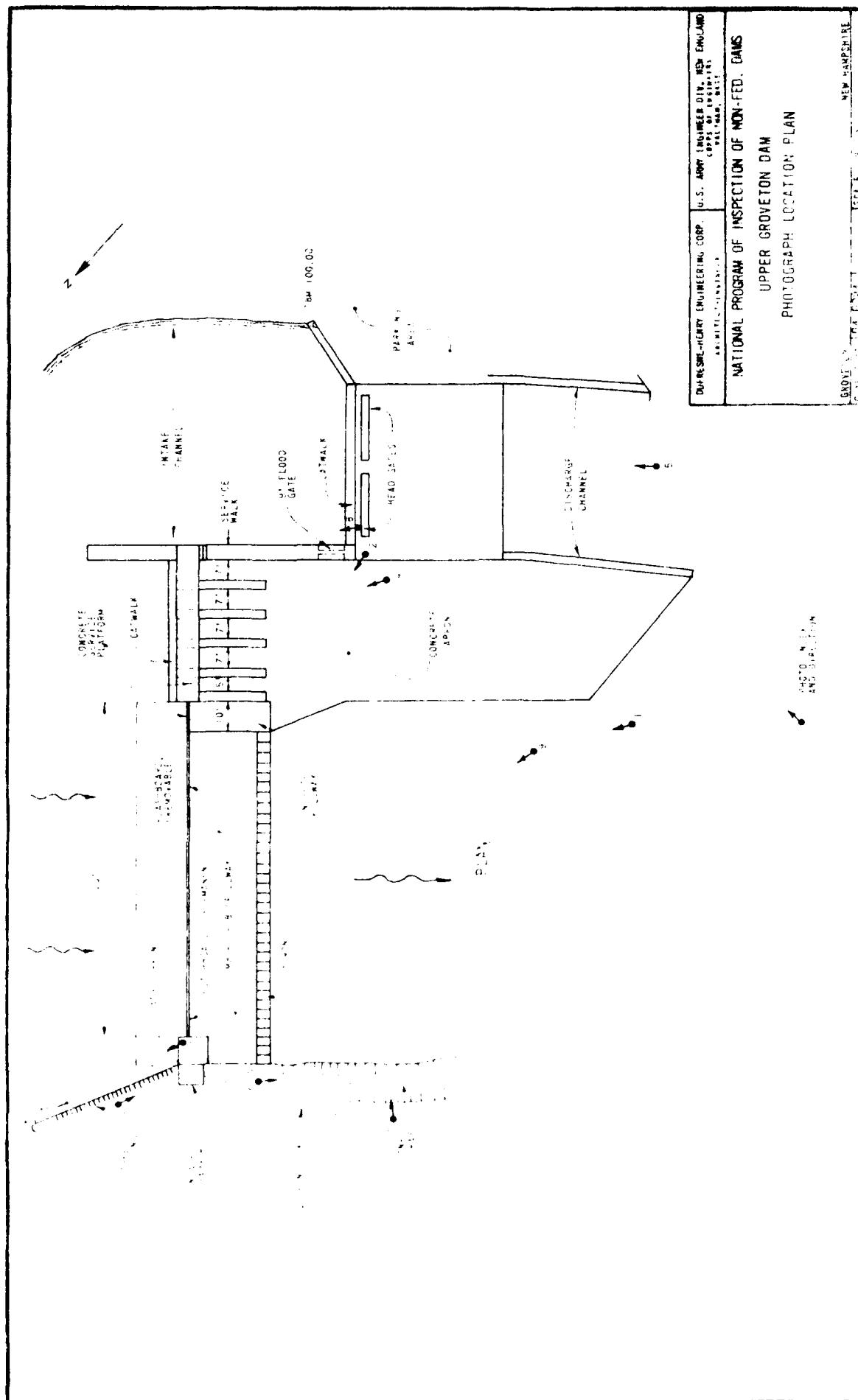
PROJECT FEATURE \_\_\_\_\_

NAME \_\_\_\_\_

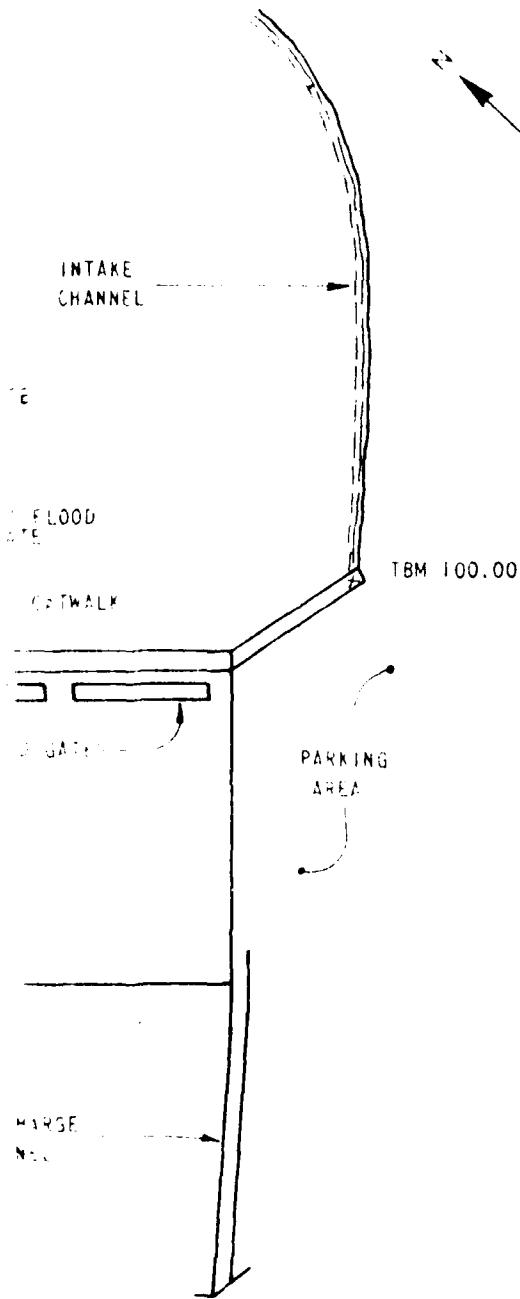
DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	NONE
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain Holes	
Channel	
Loose Rock or Trees Overhanging Channel	
Condition of Discharge Channel	



APPENDIX C  
PHOTOGRAPHS



DUFRESNE-HENRY ENGINEERING CORP. U.S. ARMY ENGINEER DIV. NEW ENGLAND  
ARCHITECT-ENGINEER CORPS OF ENGINEERS  
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

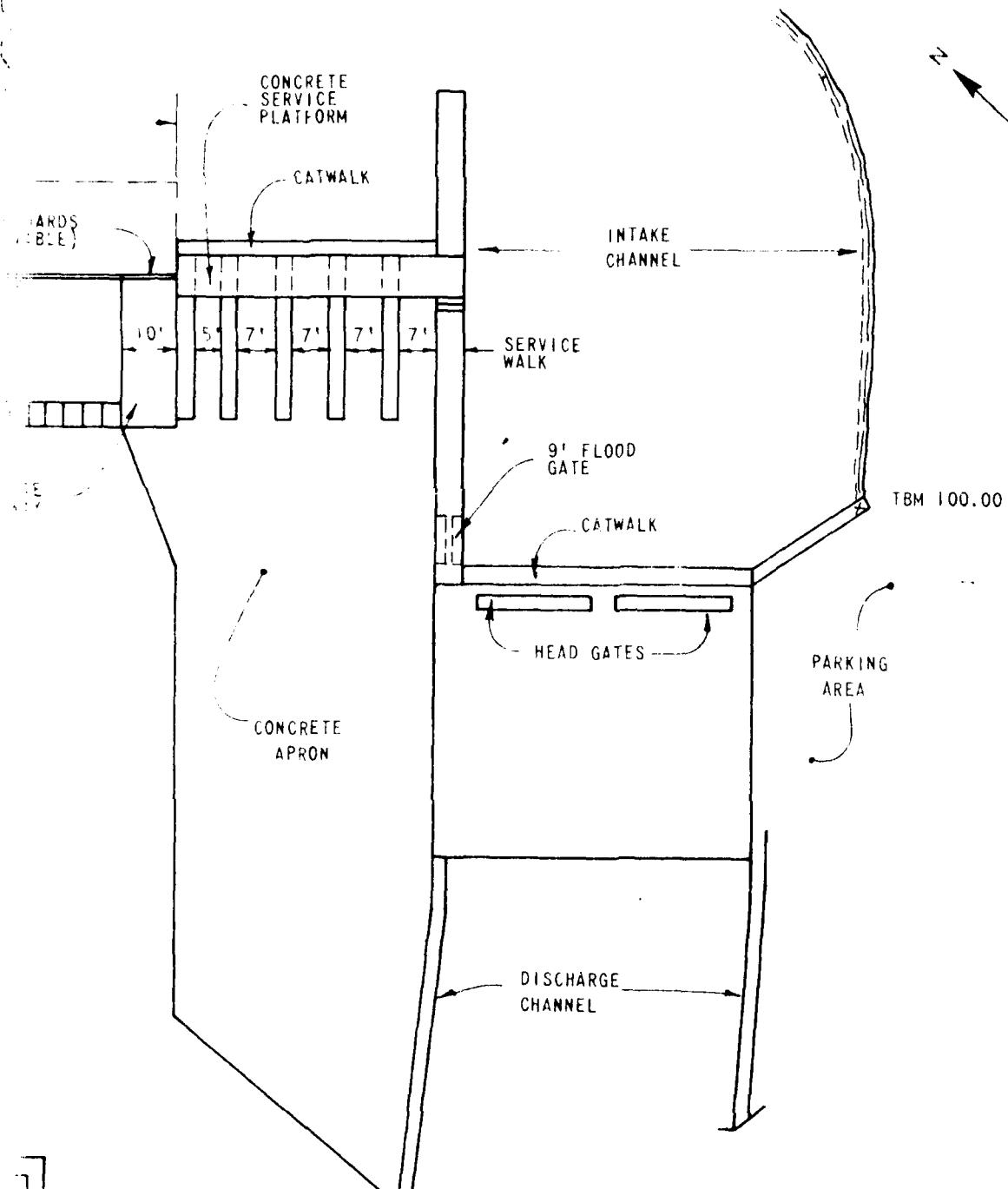
UPPER GROVETON DAM  
PLAN - ELEVATION

GROVETON

NEW HAMPSHIRE

CLIENT NO. 04-0084  
ENGR. JAD

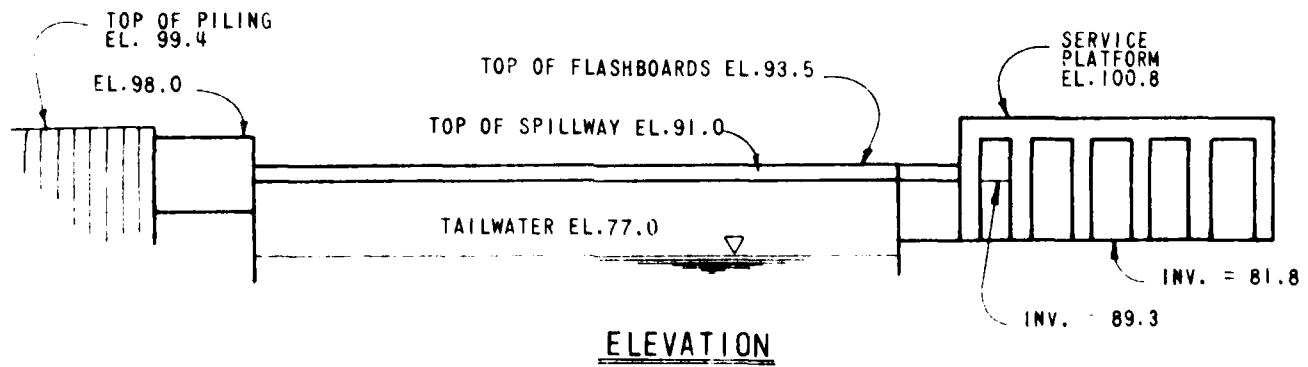
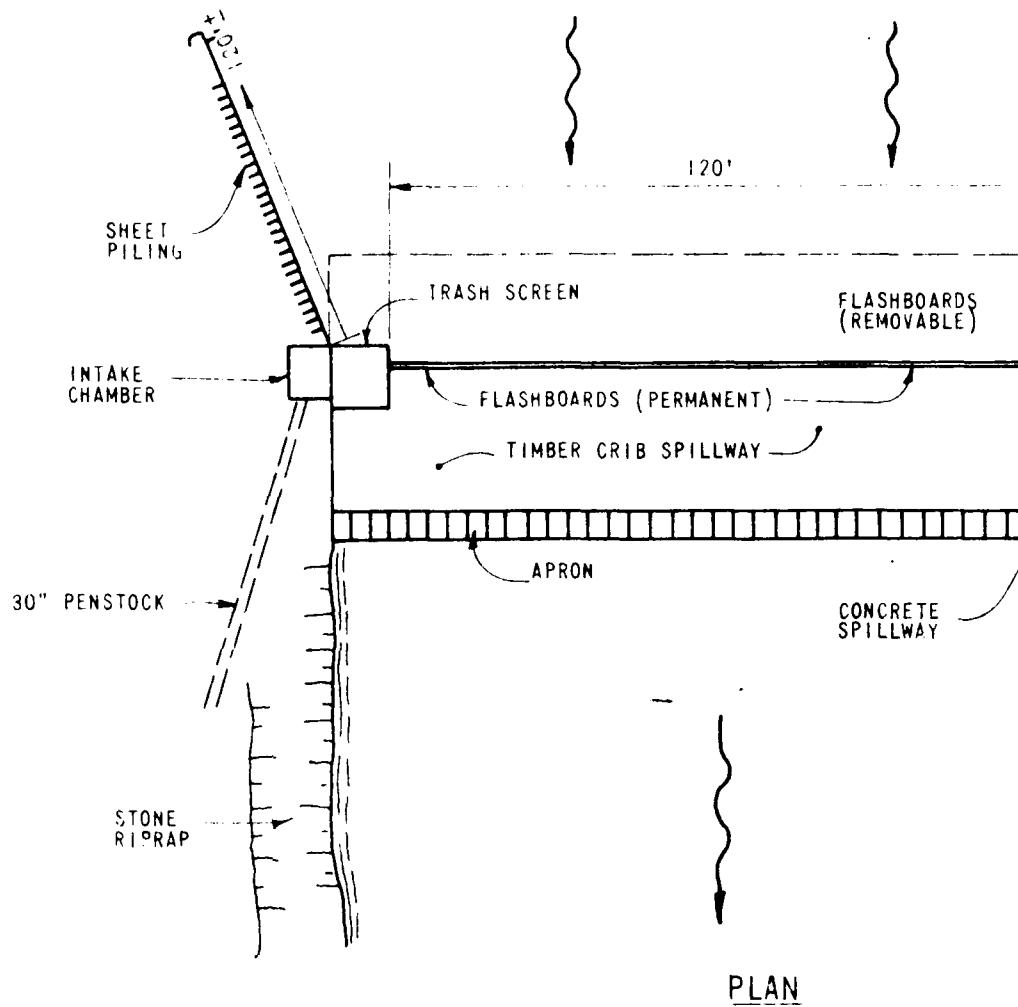
SCALE N.T.S.  
DATE 1-22-79



DUFRESNE-HENRY ENGINEERING CORP. U.S. ARMY ENGINEER  
ARCHITECT-ENGINEER CORPS OF EN-  
GALTHAM.

NATIONAL PROGRAM OF INSPECTION OF NON-  
UPPER GROVETON DAM  
PLAN - ELEVATION

GROVETON  
CLIENT NO. 04-0084 SCALE N.T.S.  
ENGR. JAD DATE 1-22-79



10/13

N. H. WATER RESOURCES BOARD  
Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Northumberland Dam Number: 182.03

Inspected by: Robert B. Chamberlin Date: Oct. 27 1972

Local name of dam or water body: \_\_\_\_\_

Owner: Groveton Paper Address: Groveton, N.H.

Owner was/was not interviewed during inspection.

Drainage Area: 263 sq. mi. Stream: Upper Ammonoosuc River

Pond Area: 25+ Acre, Storage 75 Ac-Ft. Max. Head 155 Ft.

Foundation: Type Earth, Seepage present at toe - Yes/No, \_\_\_\_\_

Spillway: Type Timber crib, Freeboard over perm. crest: 6,

Width 120, Flashboard height 3.5',

Max. Capacity \_\_\_\_\_ c.f.s.

Embankment: Type \_\_\_\_\_, Cover \_\_\_\_\_ Width \_\_\_\_\_,

Upstream slope \_\_\_\_\_ to 1; Downstream slope \_\_\_\_\_ to 1

Abutments: Type Concrete, Condition: Good, Fair, Poor

Gates or Pond Drain: Size 4-7' x full depth Capacity \_\_\_\_\_ Type \_\_\_\_\_

Lifting apparatus \_\_\_\_\_ Operational condition Good

Changes since construction or last inspection: Power house on left abutment

is now a maintenance shop. Exit sluices covered, intake trash rack on right

abutment indicates plant using water.

Downstream development: Dam No. 182.02

This dam would/would not be a menace if it failed.

Suggested reinspection date: \_\_\_\_\_

Remarks: Concrete on gate abutments eroding to show pipe casings for railing. Railing was just painted.

OK

**NEW HAMPSHIRE WATER CONTROL COMMISSION**  
**DATA ON DAMS IN NEW HAMPSHIRE**

**LOCATION**

State No. ....182.03.....  
Town .....Northumberland ..... / County Coos /  
Stream Upper Ammonoosuc /  
Basin-Primary Connecticut ..... : Secondary Upper Ammonoosuc /  
Local Name .....  
Coordinates—Lat. .... $44^{\circ} 35' 1\frac{1}{2}$  ..... : Long. .... $71^{\circ} 30' + 2200$  .....

**GENERAL DATA**

Drainage area: Controlled ..... Sq. Mi.: Uncontrolled ..... Sq. Mi.: Total ..... Sq. Mi.  
Overall length of dam 325 ..... ft.: Date of Construction .....  
Height: Stream bed to highest elev. 20 ..... ft.: Max. Structure ..... 14 ..... ft.  
Cost—Dam ..... : Reservoir .....  
DESCRIPTION Crib timber and stone concrete

**Waste Gates**

Foundation earth

Type .....  
Number ..... : Size ..... ft. high x ..... ft. wide  
Elevation Invert ..... : Total Area ..... sq. ft.  
Hoist .....  
Waste Gates Conduit

Number ..... : Materials .....  
Size ..... ft. : Length ..... ft. : Area ..... sq. ft.

**Embankment**

Type .....  
Height—Max. ..... ft.: Min. ..... ft.  
Top—Width ..... : Elev. ..... ft.  
Slopes—Upstream ..... on ..... : Downstream ..... on .....  
Length—Right of Spillway ..... : Left of Spillway .....

**Spillway**

Materials of Construction .....  
Length—Total ..... 120 ..... ft.: Net ..... ft.  
Height of permanent section—Max. ..... ft.: Min. ..... Stop. planks ..... ft.  
Flashboards—Type Fixed 1 section 8' removable ..... : Height ..... 3 $\frac{1}{2}$  ..... ft.  
Elevation—Permanent Crest ..... : Top of Flashboard .....  
Flood Capacity ..... 6540 ..... cfs.: ..... 26.4 ..... cfs/sq. mi.

**Abutments**

Materials: .....  
Freeboard: Max. ..... 5 ..... ft.: Min. ..... ft.

**Headworks to Power Devel.—(See "Data on Power Development")**

**OWNER** ..... Grafton Paper Co. /

**REMARKS** Moraine yes Condition poor being repaired and addition 1 gate built

Subject to inspection

1200  
NEW HAMPSHIRE WATER CONTROL COMMISSION  
DATA ON WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

LOCATION

AT DAM NO. 182.03

Town ..... Northumberland ..... : County ..... Coos .....

Stream ..... Upper Ammonoosuc .....

Basin-Primary ..... Connecticut ..... : Secondary ..... Upper Ammonoosuc .....

Local Name .....

GENERAL DATA

Head-Max. ..... ft.: Min. ..... ft.: Ave. ..... 9 ..... ft.

Date of Construction ..... : Use of Power ..... Industrial .....

Pondage ..... ac. ft.: Storage ..... ac. ft.

DESCRIPTION

Racks

Size of Rack Opening .....

Size of Bar ..... : Material .....

Area: Gross ..... Sq. Ft.: Net ..... sq. ft.

Head Gates

Type .....

Number ..... 1 ..... : Size ..... 2' ..... ft. high x ..... 4' ..... ft. wide

Elevation of Invert ..... : Total Area ..... sq. ft.

Hoist .....

Penstock

Number ..... : Material .....

Size ..... : Length .....

Turbines

Number ..... 2 ..... : Makers ..... 36" vertical .....

Rating HP. per unit ..... : Total Capacity ..... 800 ..... HP.

Max. Dement C.F.S., per unit ..... : Total ..... cfs

Drive

Type .....

Generator

Number ..... 2 .....

Make .....

Rating KW., per unit ..... 200 each ..... ; Total Capacity ..... K. W.

Exciter

Number ..... : Make .....

Rating-per unit ..... : Total Capacity ..... K. W.

OUTPUT—KWHRS

19..... : 19.....

19..... : 19.....

19..... : 19.....

19..... : 19.....

19..... : 19.....

## PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD

I-5427

TOWN	NORTHUMBERLAND	TOWN NO.	3	STATE NO.	172
RIVER STREAM	Upper Ammonoosuc				
DRAINAGE AREA		POND AREA			
DAM TYPE	Crib	FOUNDATION NATURE OF	Earth		
MATERIALS OF CONSTRUCTION	Timber, Stone, Concrete				
PURPOSE OF DAM	POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTATION—PUBLIC UTILITY				
HEIGHTS, TOP OF DAM TO BED OF STREAM	Approx. 20'	TOP OF DAM TO SPILLWAY CRESTS	Approx. 6'		
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM	Approx. 120'	LENGTH OF DAM Approx.			
FLASHBOARDS TYPE, HEIGHT ABOVE CREST	Fixed - 1 section 8' removable stop planks $\frac{31}{2}$ '				
OPERATING HEAD CREST TO N. T. W.	9'	TOP OF FLASHBOARDS TO N. T. W.	12'-6"		
WHEELS, NUMBER KINDS & H. P.	2-36" Vertical				
GENERATORS, NUMBER KINDS & K. W.	2 - 200 KW				
H. P. 90 P. C. TIME					H. P. 75 P. C. TIME
100 P. C. EFF.					100 P. C. EFF.
REFERENCES, CASES, PLANS, INSPECTIONS					
REMARKS					
OWNER:	Groveton Paper Co.				
CONDITION:	Poor - Being repaired & additional gates built				
MENACE:	Yes. Will be subject to periodic inspection.				

To the Public Service Commission:

The foregoing memorandum on the above dam is submitted covering inspection made Aug. 10, 1936, according to notification to owner dated Aug. 5, 1936, and bill for same is enclosed.

D. Waldo White  
Chief Engineer

Aug. 10, 1936  
Copy to Owner

APPENDIX B  
PROJECT RECORDS AND PLANS

A. Listing of Design, Construction and Maintenance Records.

None.

B. Copies of Past Inspection Reports.

1. "Inspection by New Hampshire Water Resources Board, August 10, 1936."
2. "Inspection by New Hampshire Water Resources Board, October 27, 1972."

C. Listing of Plans

Figure 1 - Upper Groveton Dam

Plan - Elevation

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAM DATE November 16, 1978

PROJECT FEATURE \_\_\_\_\_ NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_ NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>RESERVOIR</u>	
Stability of Shoreline	Good - riprap.
Sedimentation	Not known (could not measure).
Changes in Watershed Runoff Potential	None known.
Upstream Hazards	Log boom, floating logs.
Downstream Hazards	None.
Alert Facilities	None known.
Hydrometeorological Gages	None known.
Operational and Maintenance Regulations	Well maintained. Dam inspected during past 6 months. Repairs made to upstream face, 18 cubic yards of concrete placed in cavity under dam. Concrete spalling is patched regularly.

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAMDATE November 16, 1978

PROJECT FEATURE \_\_\_\_\_

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE TO GATES</u>	
a. Super Structure	
Bearings	Good.
Anchor Bolts	Good.
Bridge Seat	Good.
Longitudinal Members	Good.
Under Side of Deck	Good.
Secondary Bracing	Good.
Deck	Good.
Drainage System	N/A
Railings	Good.
Expansion Joints	Good.
Paint	Good.
b. Abutment and Piers	
General Condition of Concrete	Good.
Alignment of Abutment	Good.
Approach to Bridge	Good.
Condition of Seat and Backwall	Good.

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAMDATE November 16, 1978

PROJECT FEATURE \_\_\_\_\_

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>  a. Approach Channel Slope Conditions Bottom Conditions Rock Slides or Falls Log Boom Debris Condition of Concrete Lining Drains or Weep Holes  b. Intake Structure Condition of Concrete Stop Logs and Slots	NONE

## PERIODIC INSPECTION CHECK LIST

PROJECT UPPER GROVETON DAMDATE November 16, 1978

PROJECT FEATURE \_\_\_\_\_

NAME \_\_\_\_\_

DISCIPLINE \_\_\_\_\_

NAME \_\_\_\_\_

AREA EVALUATED	CONDITION
<u>OUTLET GATES - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	To old power house
Loose Rock Overhanging Channel	Fair to good.
Trees Overhanging Channel	None.
Floor of Approach Channel	None.
b. Weir and Training Walls	
General Condition of Concrete	Not observable.
Rust or Staining	Fair to good.
Spalling	None.
Any Visible Reinforcing	Yes - many patches generally good conditions - spalling at single gate.
Any Seepage or Efflorescence	None observed.
Drain Holes	Minimal through gates.
c. Discharge Channels	
General Condition	None observed.
Loose Rock Overhanging Channel	Good except downstream of power house.
Trees Overhanging Channel	None.
Floor of Channel	None.
Other Obstructions	Not observable



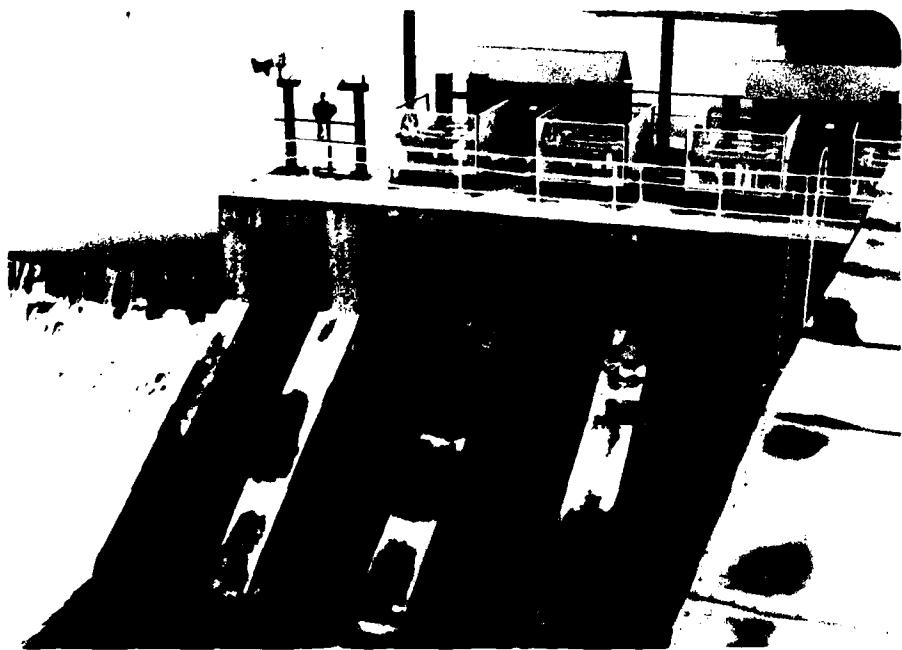
#1. OVERALL VIEW OF SPILLWAY



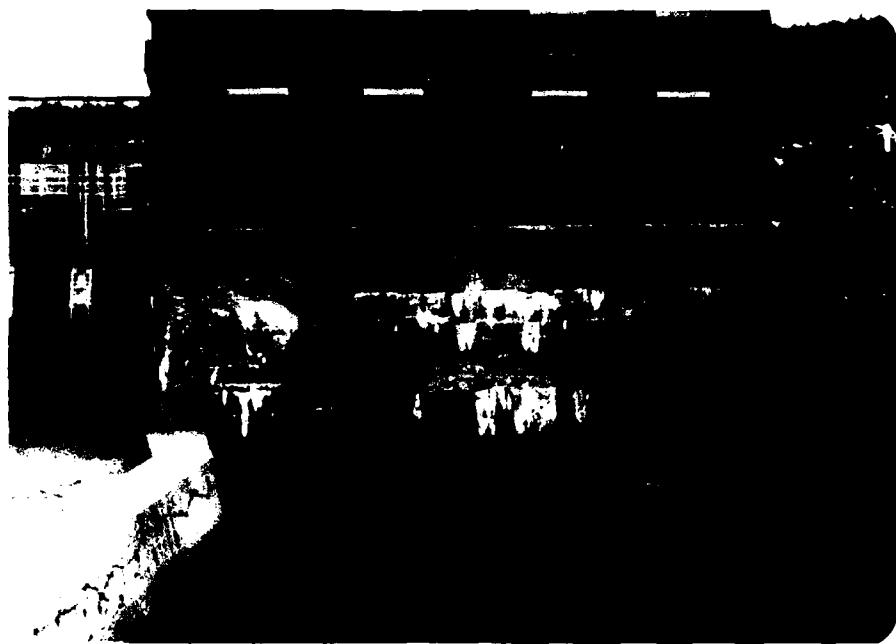
#2. VIEW OF SPILLWAY AND SHEET PILE COFFER DAM



#3. VIEW OF GATE WORKS AND POWER HOUSE



#4. VIEW OF GATE WORKS



#5. VIEW OF DOWNSTREAM WALL OF POWER HOUSE



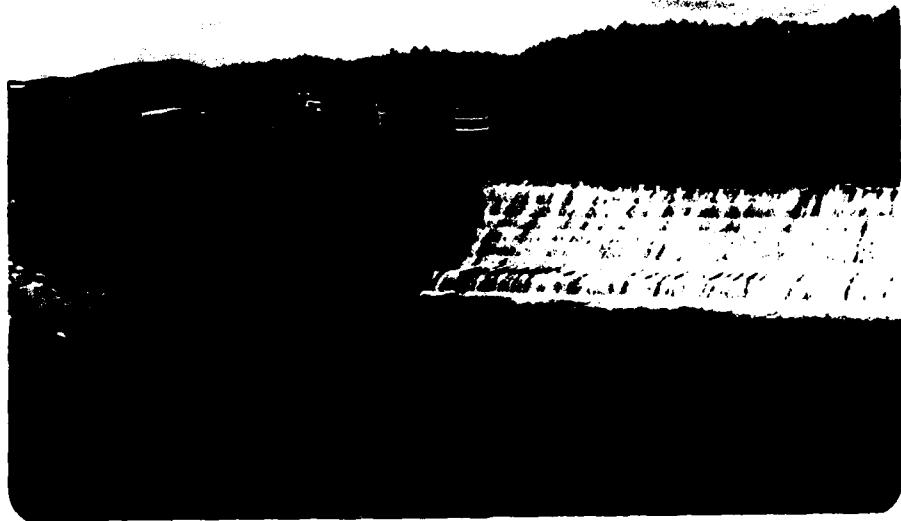
#6. VIEW OF INTAKE CHAMBER AND BAR SCREEN



#7. VIEW OF RIGHT BANK SHOWING SHEET PILE COFFER DAM



#8. VIEW OF UPSTREAM IMPOUNDMENT SHOWING LOG BOOM



#9. VIEW OF DOWNSTREAM RIGHT RIVER BANK



#10. VIEW OF RIGHT RIVER BANK AND PEDESTRIAN BRIDGE

APPENDIX D  
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

## DUFRESNE-HENRY ENGINEERING CORPORATION

BY JAD  
DATE 3-30-79SUBJECT UPPER GROVETON DAM  
SURFACE - STORAGE ESTIMATESSHEET NO.        OF         
JOB NO.       LENGTH 4200' TO UPSTREAM DAM

3200' NORMAL POOL (ESTIMATED)

4200' MAXIMUM POOL

WIDTH 225' AVERAGE

250' MAX. POOL

DEPTH 4' - AVERAGE

9' - MAX POOL

NORMAL POOL

$$\text{SURFACE} = 3200 \times 225 = 720,000 = \underline{16 \text{ ACRES}}$$

$$\text{STORAGE} = 16 \times 4 = \underline{64 \text{ AC-FT.}}$$

MAXIMUM POOL

$$\text{SURFACE} = 4200 \times 250 = 105,000 = \underline{24 \text{ ACRES}}$$

$$\text{STORAGE} = 24 \times 9 = \underline{216 \text{ AC-FT}}$$

**DUFRESNE-HENRY ENGINEERING CORPORATION**

BY J. DOHRMAN  
DATE 2-20-79

SUBJECT UPPER GROVEON DAM  
HYD. CALCULATIONS

SHEET NO. 1 OF 7  
JOB NO. 04-0084

SPILLWAY CAPACITY

LENGTH = 120'

HEIGHT = 4.5' TO TOP OF RIGHT ABUTMENT

$C_w = 3.45$

ELEV 98.0

$$Q = C_w L H^{3/2} = (3.45) (120) (9.54) = 3949 \text{ CFS.}$$

(WITH FLASH BOARDS)

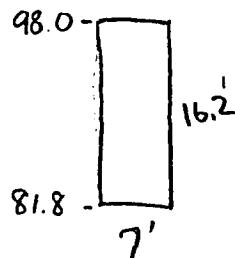
$$Q = (3.45)(120)(18.5) =$$

7,659 CFS

(WITHOUT FLASH BOARDS)

GATES

4



$l = 7'$

$H = 16.2$

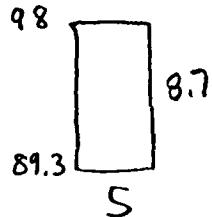
$C = 3.30$

$$Q = C_w L H^{3/2}$$

$$= (3.3)(7)(65.2) = 1506 \text{ C.F.S.}$$

$$4 \times 1502 = \underline{6025 \text{ C.F.S.}}$$

1



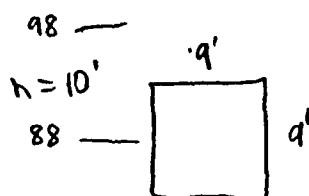
$l = 5$

$H = 8.7$

$C = 3.30$

$$Q = (3.3)(5)(25.7) = \underline{423 \text{ C.F.S.}}$$

1



$$\text{ORIFACE FLOW } Q = C_d A \sqrt{2g h} = 1644 \text{ CFS}$$

$C_d = .80$

TOTAL CAPACITY @ EL. 98.0

TOTAL CAPACITY = 12,044 C.F.S.

## DUFRESNE-HENRY ENGINEERING CORPORATION

J. DOHRMAN  
2-20-79SUBJECT UPPER GROVETON DAM  
HYD. CALCULATIONSSHEET NO. 2 OF 7  
JOB NO. 04-0084EST FLOOD = 100 YEAR EXCEEDANCE INTERVAL

TEST FLOOD CALCULATED FOR GAUGE 01080101

IN GROVETON 2.8 MILES UPSTREAM OF DAM

DRAINAGE AREA TO GAUGE = 232 mi<sup>2</sup>

DRAINAGE AREA TO DAM = 243

$$\frac{243}{232}^{.75} = 1.03$$

100 YEAR FLOOD AT GAUGE = 12,700 CFS (SEE ATTACHED)

100 YEAR FLOOD AT DAM =  $1.03(12,700) = \underline{\underline{13,100 \text{ CFS}}}$ 

(SEE COMPUTER PRINTOUT FOR TEST FLOOD CALCULATION)

STORAGE ROUTING

DRAINAGE AREA = 243 SQ. MI. = 155,520 ACRES

STORAGE AREA OF RESERVOIR = 35 ACRES (ESTIMATED)

STORAGE RATIO =  $\frac{35}{155,520} = .022 \%$

ACCORDING TO U.S.D.A. SOIL CONSERVATION SERVICE  
PRACTICES, STORAGE RATIOS BELOW .20% HAVE  
INSIGNIFICANT EFFECTS ON FLOW REDUCTION.STORAGE CAPACITIESSINCE THE DAM IS A RUN OF THE RIVER DAM,  
STORAGE CAPACITIES WERE NOT CALCULATED.

## FLOOD FLOW FREQUENCY COMPUTATION

## 0113000C UPPER AMmonoSUC RIVER NEAR GRETTON, NEW HAMPSHIRE

DAY	MONTH	YEAR	FLOW	ORDERED	RANK	PLOT POS
0	0	1961	5440.	9450.	1	0.0263
0	0	1962	5230.	8880.	2	0.0526
0	0	1963	4740.	7580.	3	0.0709
0	0	1964	6350.	7630.	4	0.1053
0	0	1965	6880.	6430.	5	0.1316
0	0	1966	2140.	6580.	6	0.1574
0	0	1967	7580.	6540.	7	0.1842
0	0	1968	3690.	6430.	8	0.2105
0	0	1969	5550.	6530.	9	0.2363
0	0	1970	6150.	6240.	10	0.2632
0	0	1971	5460.	5530.	11	0.2945
0	0	1972	4410.	5460.	12	0.3158
0	0	1973	9450.	5460.	13	0.3421
0	0	1974	8880.	5220.	14	0.3694
0	0	1975	6430.	5040.	15	0.3947
0	0	1976	3430.	4930.	16	0.4211
0	0	1977	3030.	4910.	17	0.4474
0	0	1978	6540.	4860.	18	0.4737
0	0	1979	2580.	4760.	19	0.5000
0	0	1980	6430.	4750.	20	0.5263
0	0	1981	4760.	4740.	21	0.5526
0	0	1982	4760.	4540.	22	0.5709
0	0	1983	4540.	4330.	23	0.6053
0	0	1984	4740.	4360.	24	0.6316
0	0	1985	1970.	4320.	25	0.6579
0	0	1986	2070.	3930.	26	0.6842
0	0	1987	3530.	3630.	27	0.7105
0	0	1988	3430.	3550.	28	0.7368
0	0	1989	5530.	3530.	29	0.7632
0	0	1990	6930.	3530.	30	0.7895
0	0	1991	4320.	3320.	31	0.8158
0	0	1992	7430.	3200.	32	0.8421
0	0	1993	6660.	3070.	33	0.8604
0	0	1994	5460.	2870.	34	0.8847
0	0	1995	3320.	2740.	35	0.9021
0	0	1996	4360.	2660.	36	0.9474
0	0	1997	6530.	1970.	37	0.9737

MEAN 3.6697

STD DEV 0.1553

COMPUTED SKEW -0.1644

REGIONAL SKEW 0.5000

ADOPTED SKEW 0.3437

COMPUTED FLOW	EXPECTED-PROBABILITY FLOW	PROBABILITY	•95 LIMIT
15530.	17519.	0.002	21129.
13389.	14626.	0.005	17622.
11889.	12716.	0.010	15245.
10489.	11156.	0.020	11030.
9150.	9461.	0.040	8738.
7863.	10110.	0.100	7101.
6254.	6313.	0.200	5034.
4506.	4566.	0.500	4133.
3443.	3420.	0.800	3029.
3343.	3376.	0.900	2594.
2709.	2713.	0.950	3073.
2258.	2161.	0.990	1860.

COMPUTED FLOW	EXPECTED-PROBABILITY FLOW	PROBABILITY	•95 LIMIT
15530.	17519.	0.002	21129.
13389.	14626.	0.005	17622.
11889.	12716.	0.010	15245.
10489.	11156.	0.020	11030.
9150.	9461.	0.040	8738.
7863.	10110.	0.100	7101.
6254.	6313.	0.200	5034.
4506.	4566.	0.500	4133.
3443.	3420.	0.800	3029.
3343.	3376.	0.900	2594.
2709.	2713.	0.950	3073.
2258.	2161.	0.990	1860.

3 OF 7

## DUFRESNE-HENRY ENGINEERING CORPORATION

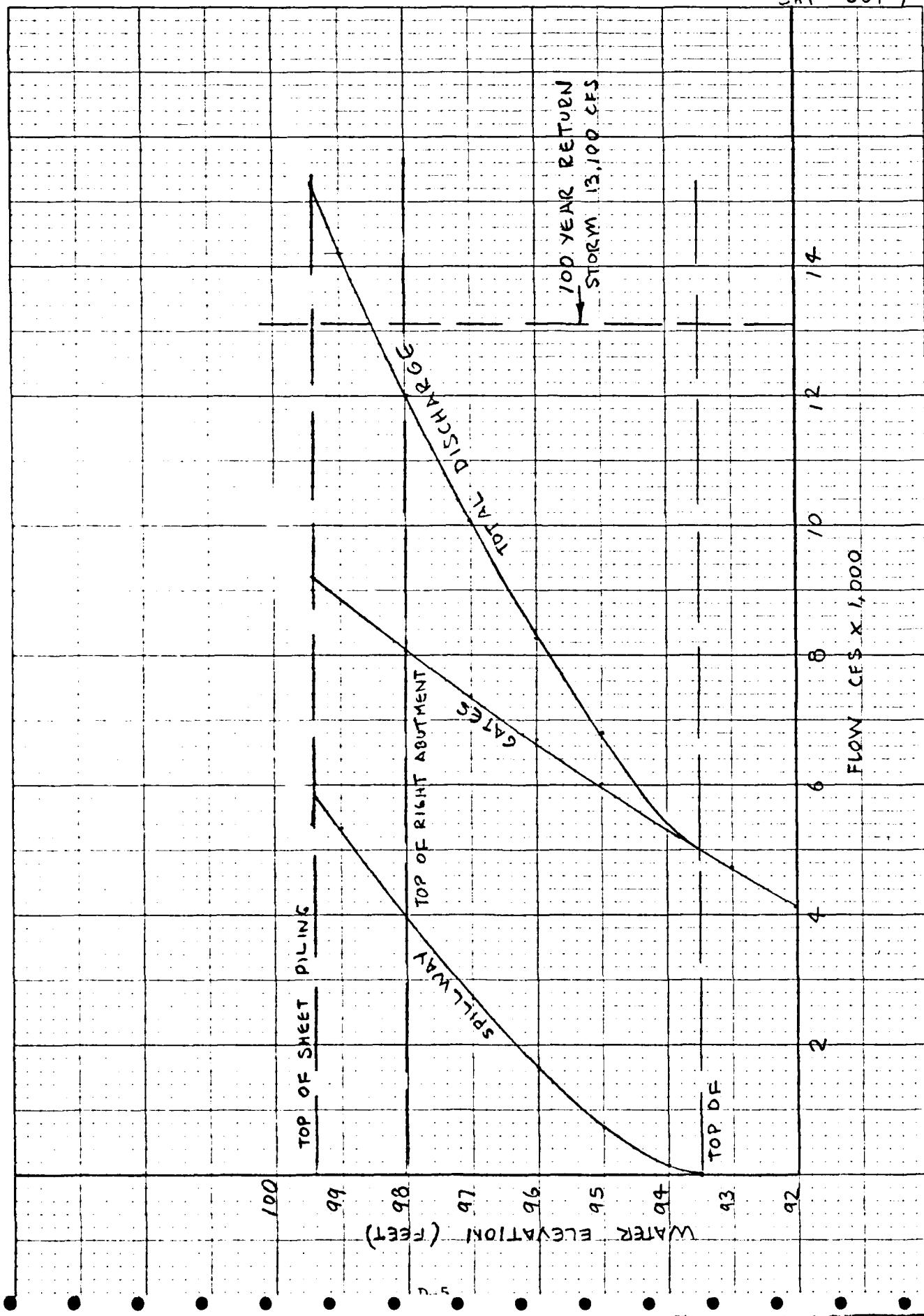
J. DOHRMAN

DATE 2-20-79

SUBJECT UPPER GROVETON DAM  
HYD CALCULATIONSSHEET NO. 4 OF 7  
JOB NO. 04-0084

ELEV.	MAIN SPILLWAY	7' GATES (4)	5' GATE (1)	9' GATE (1)	TOTAL GATES	TOTAL FLOW Q
hw	Q	hw	Q	hw	Q	Q
92	0	0	10.2	3010	2.7	73
93	0	0	11.2	3463	3.7	117
94	.5	146	12.2	3937	4.7	168
95	1.5	761	13.2	4431	5.7	224
96	2.5	1636	14.2	4944	6.7	286
97	3.5	2711	15.2	5476	7.7	352
98	4.5	3952	16.2	6025	8.7	423
99	5.5	5340	17.2	6591	9.7	498

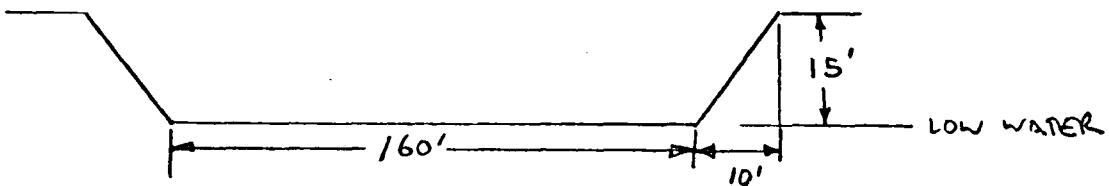
SHT SOFT



## DUFRESNE-HENRY ENGINEERING CORPORATION

J. DOHRMAN  
2-20-79SUBJECT UPPER GROVETON DAM  
HYD. CALCULATIONSSHEET NO. 6 OF 7  
JOB NO. 04-0084FAILURE ANALYSISDAM HEIGHT = 20 FEET  
LENGTH OF SPILLWAY = 120 FEET

## APPROXIMATE X-SECTION OF RIVER BELOW DAM



$$A = 170 \times 15 = 2550 \text{ FT}^2$$

$$\begin{aligned} \text{MAX STORAGE OF RESERVOIR} &= 380 \text{ ACRES-FEET} \\ &= 16,552,800 \text{ FT}^3 \end{aligned}$$

$$16,552,800 / 2550 = 6491 \text{ FT} = 1.2 \text{ MILES}$$

NOTE: BECAUSE OF THE HEIGHT TO LENGTH RATIO AND TYPE CONSTRUCTION IT IS HIGHLY UNLIKELY THAT AN INSTANTANEOUS FAILURE OF THE DAM WOULD OCCUR ALONG THE ENTIRE LENGTH OF THE DAM.

LOW FLOW FAILURE

A DAM FAILURE UNDER LOW FLOW CONDITIONS WOULD RESULT IN A FLOOD WAVE APPROXIMATELY 10 FEET HIGH IMMEDIATELY DOWNSTREAM OF THE DAM. THE AVAILABLE STORAGE IN THE DOWN STREAM CHANNEL IS MORE THAN ADEQUATE TO DISSIPATE THE FLOOD FLOW WITHOUT OVERBANK FLOW.

HIGH FLOW FAILURE

DURING HIGH FLOW CONDITIONS THE DAM WILL BE PARTIALLY BACKWATERED. THE ACTUAL DEPTH OF BACKWATER CANNOT BE DETERMINED

## DUFRESNE-HENRY ENGINEERING CORPORATION

DOHRMAN  
2-20-71SUBJECT UPPER GROVETON DAM  
H.D. CALCULATIONSSHEET NO. 7 OF 7  
JOB NO. 04-0084

WITHOUT EXTENSIVE INVESTIGATION OF DOWNSTREAM CONDITIONS. THE BACK WATER WOULD REDUCE AVAILABLE STORAGE IN THE DOWN STREAM CHANNEL AND ALSO EFFECTIVELY REDUCE THE FLOOD WAVE SHOULD A FAILURE OCCUR. THESE TWO WOULD EFFECTIVELY CANCEL EACH OTHER AND ANY REDUCED FLOOD WAVE WOULD BE CONTAINED WITHIN THE RIVER CHANNEL.

DAM FAILURE FLOW

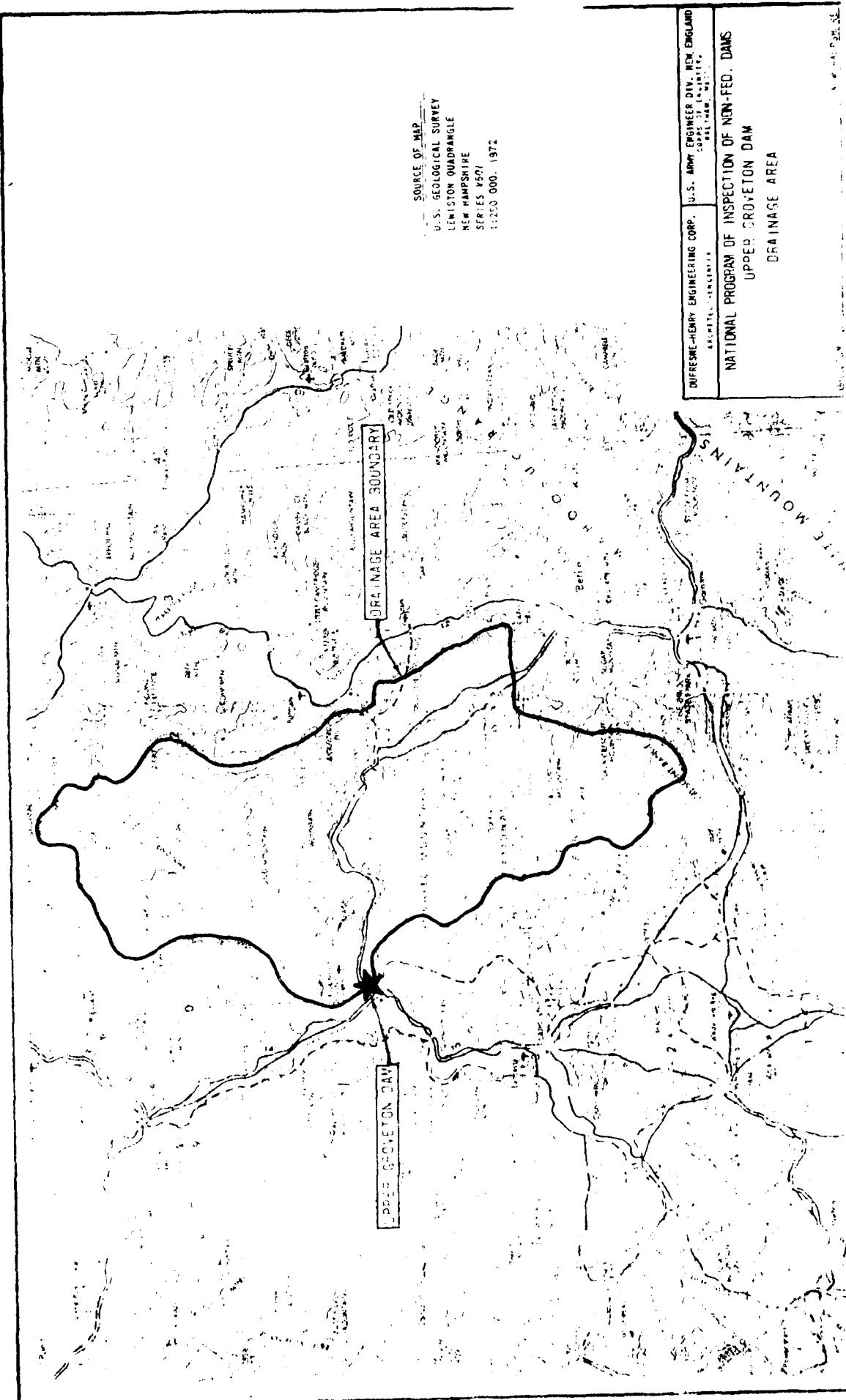
$$Q = \frac{8}{27} W_b V_g Y_o^{3/2}$$

$$W_b = .4 (250) = 100 \text{ FT.}$$

$$Y_o = 21 \text{ FT}$$

$$Q = \frac{8}{27} (100) (5.67) (96.23) = 16,166 \text{ CFS}$$

SAY 16,200 CFS



APPENDIX E

Information as Contained in the National Inventory of Dams

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE IDENT. NO.	(2) STATE NUMBER	(3) COUNTY	(4) COUNTY DIST.	(5) COVER	(6) NAME	(7) LATITUDE NORTH	(8) LONGITUDE WEST	(9) REPORT DATE DAY MO YR
NH	144	DAVENPORT	STAFF	COMIN	UPPER GROVELON DAM	44 50 . 5	71 30 . 5	01 MAY 79
(10) POPULAR NAME					(11) NAME OF IMPOUNDMENT			
MELROSE DAM					UPPER AMmonoSUC RIVER			
(12) RIVER OR STREAM					(13) NEAREST DOWNSTREAM CITY - TOWN - VILLAGE			
UPPER AMmonoSUC RIVER					NORTHUMBERLAND			
(14) TYPE OF DAM					(15) PURPOSES			
PRACTICAL					YEAR COMPLETED	SPRING FLOW NORMA	HYDRO NORMA	IMPOUNDING CAPACITIES NORMA
1920					S	21	21	MAXIMUM NORMA
(16) REMARKS					(17) DIST. FROM DAM (MIL.)			
1920 S 21 11MTH CMB, STUNT, CUNC 22-APPHUX, MAJ REPAIRS & 66' INL					0 2493			
(18) SPILLWAY					(19) POWER CAPACITY			
WALL, 120' WIDTH, 120' VERT. 120' HGT.					MAXIMUM DISCHARGE (A.Y.)	VOLUME OF DAM (C.Y.)	INSTALLED POWER (D)	NAVIGATION LOCKS
525					120	3950	1200	WPT. 116' (120')
(20) OWNER					(21) ENGINEERING BY			
NH WATER RES BD					CONSTRUCTION			
(22) DESIGN					(23) REGULATORY AGENCY			
NH WATER RES BD					OPERATION			
(24) MAINTENANCE					(25) AUTHORITY FOR INSPECTION			
(26) INSPECTION BY					(27) INSPECTION DATE			
US ARMY ENGINERS					16 NOV 78			
(28) PUBLIC LAW					92-567 JUN 1972			
(29) REMARKS					(30)			

**END**

**FILMED**

**8-85**

**DTIC**